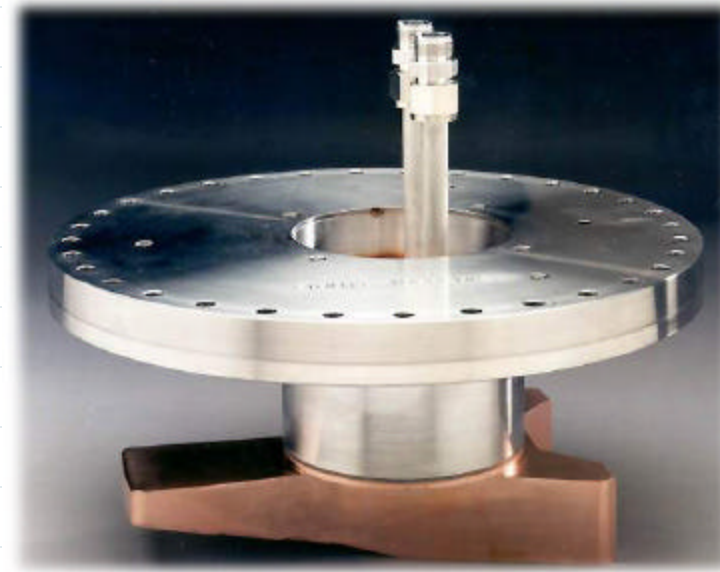


# SYSTEM RESPONSIBILITIES

- SR ABSORBERS WATER COOLING CIRCUITS
- PAR, BOOSTER AND SR KICKER MAGNETS
- APS PW TEMPERATURE CONTROL USING PLC'S
- VIBRATION MONITORING OF PUMPS AND MOTORS
- OTHER USEFUL CONTRIBUTIONS

## SR ABSORBER WATER CIRCUITS AND FLOW MONITORING

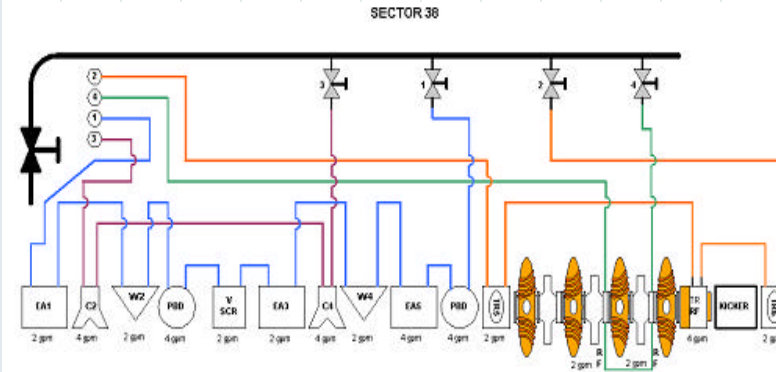
- 240+ Absorbers at strategic locations in vacuum chamber protect uncooled surfaces from x-ray radiation.



Crotch absorber

## SR ABSORBER WATER CIRCUITS AND FLOW MONITORING

- Absorbers have been grouped together to form 3 or 4 cooling circuits per sector.

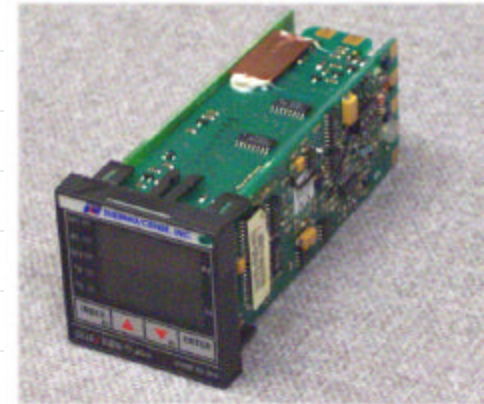


- Flow through each circuit is 2 or 4 gpm and measured by YOKAGOWA flowmeters.



# SR ABSORBER WATER CIRCUITS AND FLOW MONITORING

- 124 Love controller readouts in 40 consoles display and interlock flows.



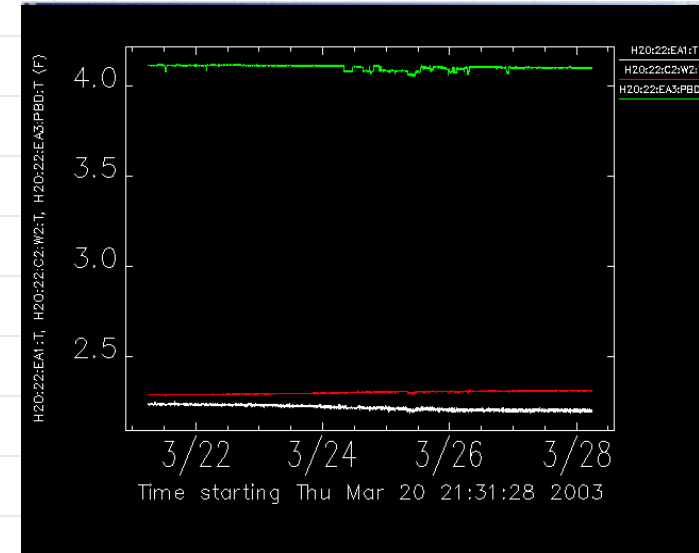
Rick Putnam  
3/18/2003

Mechanical Engineering Group  
Accelerator Systems Division

Advanced  
Photon  
Source  
Argonne National Laboratory

# SR ABSORBER WATER CIRCUITS AND FLOW MONITORING

- Preventive monitoring of flow readings by WEB page, EPICS screens and bi-weekly rounds.
- This close monitoring results in the replacement of approx. 6 – 8 units per year due to erratic readings and noncommunication. This is done to prevent beam interruptions due to Love controller failures.



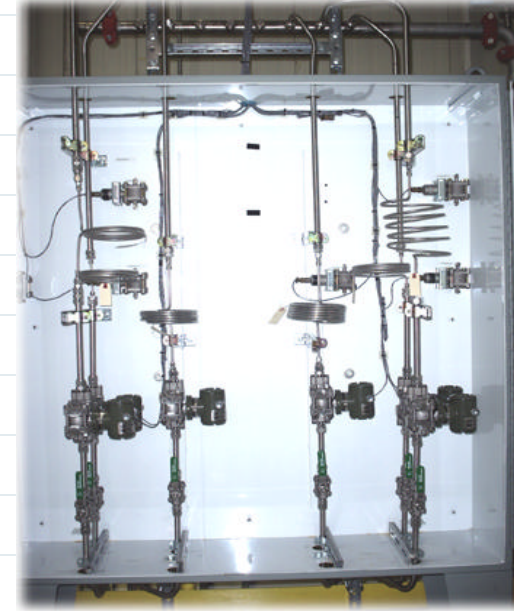
Absorber flow web page



# SR ABSORBER WATER CIRCUITS AND FLOW MONITORING

## UPGRADES FOR RELIABILITY

- Flow measuring and determining elements moved to top of Storage Ring tunnel.
- This eliminates radiation damage and for allows for maintenance with no tunnel access.
- Replaced Griswold flow regulators with a coiled length of SS tubing trimmed to give the desired flow.



Absorber flow cabinet



Griswold flow regulators

# SR ABSORBER WATER CIRCUITS AND FLOW MONITORING

## UPGRADES FOR RELIABILITY

- Replace Love controllers with PLC system.
- This allows more reliability (less electronics) better communications (ethernet) and the ability to add other sensors for more predictive monitoring.



Love Controller console



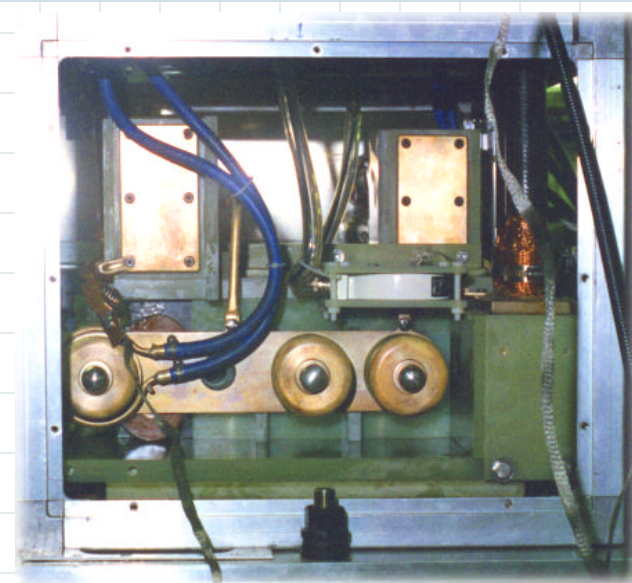
A-B CONTROLLOGIX CHASSIS



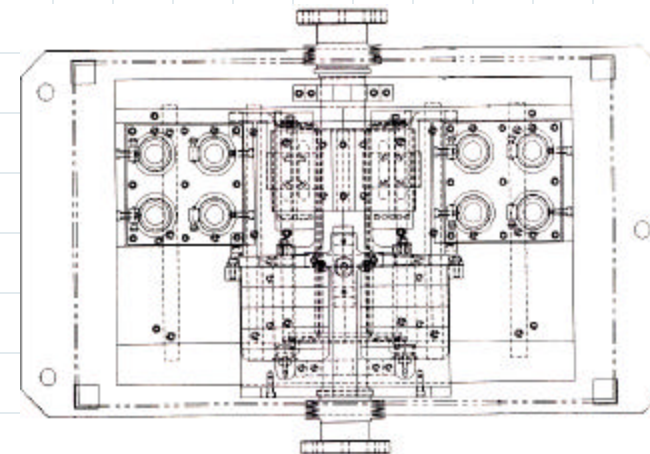
## APS KICKER MAGNETS

- PAR Kickers – Injection and Extraction
- Booster Kickers – Injection and Extraction
- SR. Kickers – Injection and Pinger

Preventive maintenance  
Spare parts  
Ceramic Vacuum chambers



PAR Injection Kicker

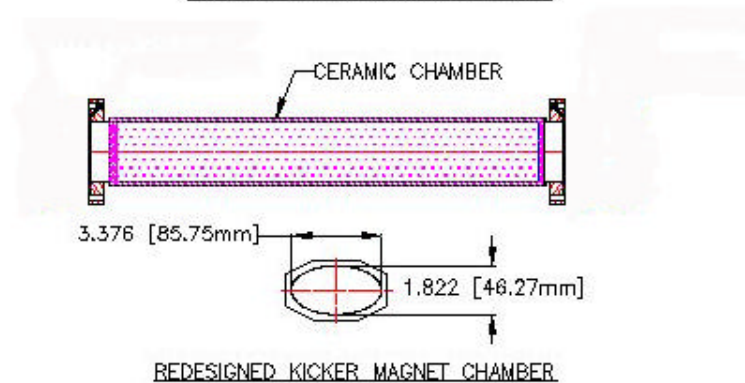
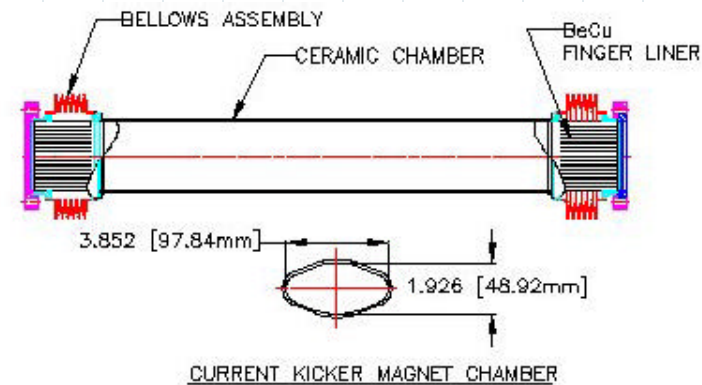


Booster Injection Kicker



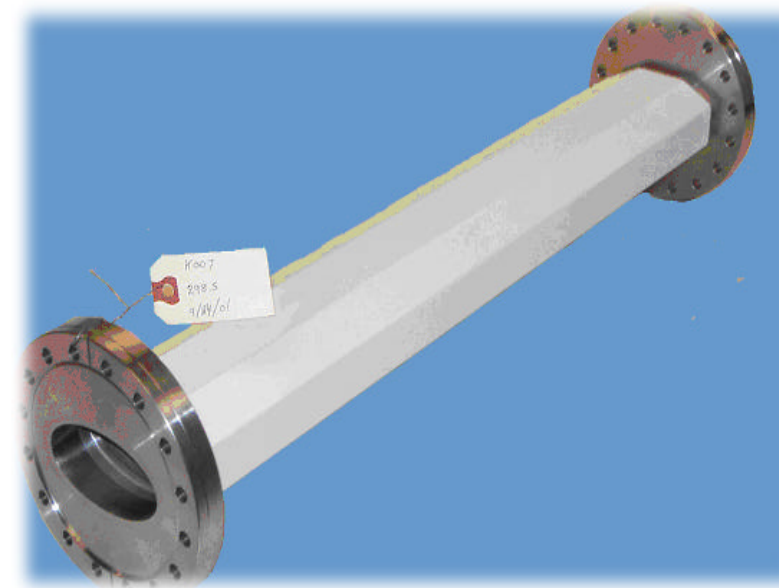
## SR KICKER MAGNET CERAMIC VACUUM CHAMBER

- Redesigned chamber for better reliability.
- Mo/Mg internal coating wetted to inside ceramic surface.
- LESS variance of internal resistance from chamber to chamber
- Reduced heating by eliminating bellows and fingers



## SR KICKER MAGNET CERAMIC VACUUM CHAMBER

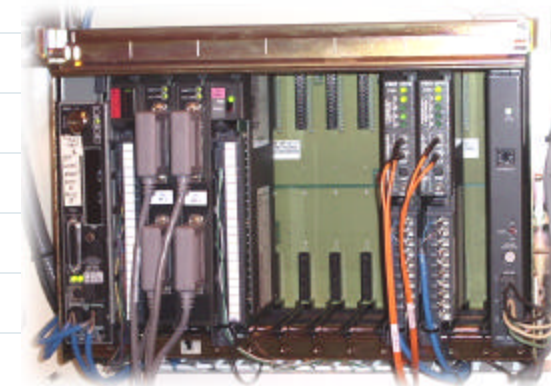
- 12 chambers in-house
- Measured magnetically
- Vacuum tested
- Ready for installation



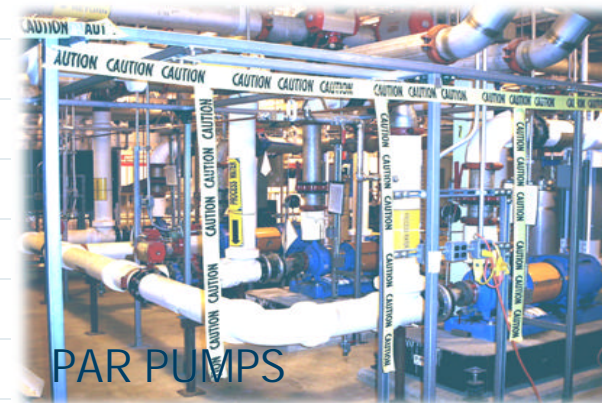
NEW CHAMBER

# TEMPERATURE CONTROL OF SECONDARY WATER SYSTEMS USING A-B PLC'S

- Temperature control using AB PLC's.
- Typical control is  $\pm .2$  degree F.
- Areas Completed
  - Storage ring
  - RF East & West
  - Booster North
  - Linac skids
- Areas in progress.
  - Par
  - Booster South
  - Leutl



RF EAST A-B SYSTEM

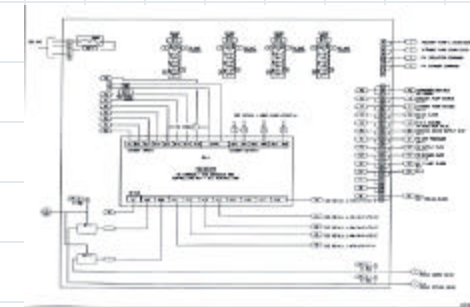


PAR PUMPS

# TEMPERATURE CONTROL OF SECONDARY WATER SYSTEMS USING A-B PLC'S

## CONVERSION TO FULL A-B CONTROL

- METSYS LCP and DX9100 failures.
- Next logical step is to convert Control of pumps from Johnson Controls to A-B PLC's.
- A-B PLC-5 systems VERY reliable.
- Better communication with EPICS - gives easier access to real time and archived data (screens and web pages).



### Sequence of Operations

#### Process Water Control

Primary process water will be provided through the system in building 428, (1111111111). See Johnson Controls, Inc. drawing YC-9-A-B-2A for the sequence of operations.

Local chilled process water bridges will provide a secondary loop for each of the APC areas. The building operating engineer will enable the individual system by setting binary data point, (1111111111) 30 from their respective ICS network terminal. The digital control panel, (1111111111) will open process water restriction valve, (1111111111) and close the flow, (1111111111) valve under control and start the secondary circulating pump. (1111111111) will open process water control valve, (1111111111) will be monitored by digital control panel, (1111111111) to maintain a process water temperature setpoint of 55 F. (1111111111) at an ICS terminal.

The digital control panel will provide the start/stop command for each process water circulating pump and will monitor their status through feedback devices, differential pressure switches, (1111111111) and (1111111111). An alarm, Pump, (1111111111) Failure will be issued to the ICS network in the event of failure.

The status of the secondary filter system will be monitored by differential pressure switch, (1111111111). In the event that the differential pressure exceeds 40 PSI, an alarm, Dirty Filter Condition will be sent to the ICS network.

#### High Process Water Supply Temperature Event

The digital controller will monitor the process water supply temperature through temperature element, (1111111111). In the event that the supply water temperature exceeds 90 F. (adjustable) an alarm will be issued to the ICS network High Proc. Water Temp.

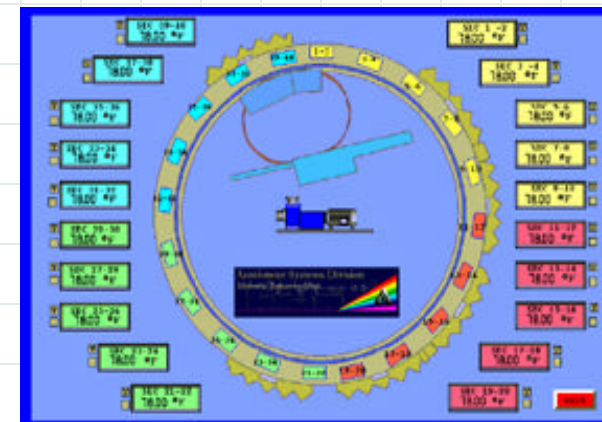
# TEMPERATURE CONTROL OF SECONDARY WATER SYSTEMS USING A-B PLC'S

## CONVERSION TO FULL A-B CONTROL

- Convert J-C functions and operations.
- A-B systems are widely used at APS.
- Programming both ladder logic and Human Machine Interface (HMI) will be done in-house.
- Maintenance and repair will be faster and easier.
- Reduced spares inventory.



Ladder logic



RSView 32 HMI

## TEMPERATURE CONTROL OF SECONDARY WATER SYSTEMS USING A-B PLC'S

- HMI for preventive monitoring and programming of A-B systems.
- Training of personnel both in-house and at A-B to do programming and maintenance.



TECHNICIAN WORKSTATION



TECHNICIAN TRAINING  
AREA

Rick Putnam  
3/18/2003

**Mechanical Engineering Group**  
Accelerator Systems Division

Advanced  
Photon  
Source  
Argonne National Laboratory

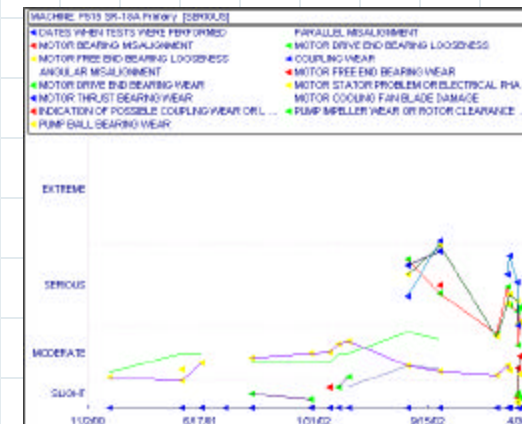


# VIBRATION MONITORING OF MOTORS AND PUMPS IN PROCESS WATER SYSTEMS

- SR mezzanine, RF galleries, Booster and PAR systems.
- Vibration data collected on motor and pump bearings, couplings, and proper alignment.
- Are adding user SR DI skids and Linac water skids.



COLLECTING DATA



Rick Putnam  
3/18/2003

Mechanical Engineering Group  
Accelerator Systems Division

Advanced  
Photon  
Source  
Argonne National Laboratory

# VIBRATION MONITORING OF MOTORS AND PUMPS IN PROCESS WATER SYSTEMS

- Collected data is processed and findings displayed.
- Depending on severity level preventive maintenance service is performed if indicated.
- Many failures of pumps and motors have been prevented by use of this predictive maintenance and analysis system.

## P515 SR-18A Primary

Report generated on: 3/12/03 02:13 PM

Acquired: 3/12/03 02:13 PM 1xM = 3585 RPM Averages: 9

Maximum level: 113 (+8) VdB at 5xM on 3R in low range

### RECOMMENDATIONS:

**IMPORTANT: REPLACE MOTOR FREE END BEARING**  
**IMPORTANT: REPLACE MOTOR DRIVE END BEARING**  
**IMPORTANT: REPLACE COUPLING AND ALIGN UNIT.**

### DIAGNOSES:

#### SERIOUS COUPLING WEAR

91 (+16) VdB at 3xM	on 2A in low range
95 (+16) VdB at 3xM	on 2R in low range
100 (+14) VdB at 3xM	on 2T in low range
90 (+6) VdB at 3xM	on 3R in low range
97 (+9) VdB at 3xM	on 3T in low range
109 (+5) VdB at 1xM	on 2A in low range
107 (+11) VdB at 1xM	on 3A in low range
85 (+27) VdB at 6xM	on 2A in low range
91 (+26) VdB at 6xM	on 2R in low range
90 (+24) VdB at 6xM	on 2T in low range

#### SERIOUS MOTOR FREE END BEARING LOOSENESS

91 (+15) VdB at 4xM	on 1R in low range
92 (+27) VdB at 6xM	on 1R in low range
81 (+9) VdB at 14xM	on 1R in high range
101 (+18) VdB at 4xM	on 1T in low range
86 (+23) VdB at 6xM	on 1T in low range
94 (+16) VdB at 3xM	on 1A in low range
101 (+18) VdB at 3xM	on 1R in low range
105 (+22) VdB at 3xM	on 1T in low range
85 (+9) VdB at 1.33xM	on 1A in low range
109 (+6) VdB at 1xM	on 1A in low range
99 (+8) VdB at 1xM	on 1R in low range
104 (+4) VdB at 1xM	on 1T in low range

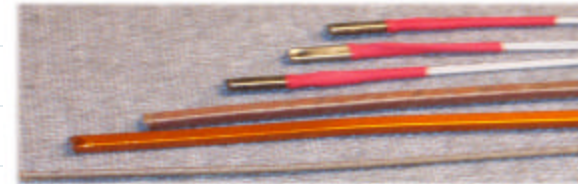
#### SERIOUS MOTOR DRIVE END BEARING LOOSENESS

85 (+27) VdB at 6xM	on 2A in low range
87 (+14) VdB at 4xM	on 2R in low range
91 (+26) VdB at 6xM	on 2R in low range
80 (+7) VdB at 14xM	on 2R in high range
97 (+16) VdB at 4xM	on 2T in low range
90 (+24) VdB at 6xM	on 2T in low range
91 (+16) VdB at 3xM	on 2A in low range
95 (+16) VdB at 3xM	on 2R in low range
100 (+14) VdB at 3xM	on 2T in low range
109 (+5) VdB at 1xM	on 2A in low range
104 (+4) VdB at 1xM	on 2R in low range
106 (+5) VdB at 1xM	on 2T in low range

## SOME OTHER CONTRIBUTIONS, SUPPORT AND RESPONSIBILITIES

### ➤ MAGNETS AND COILS

Winding, insulation,  
Vacuum impregnation  
Thermal protection.



### ➤ EPOXIES AND FORMULATIONS

### ➤ INSTRUMENTATION

Sensors and transmitters  
Data collection  
Temperature control and measurement  
Flow measurement

FORMULATION		
DER 332	-	100 PBW
NMA	-	90 PBW
BDMA	-	1.5 PBW
CURE CYCLE		
HEAT MOLD AND FILL		130 F.
GEL FOR	4 HRS.	190 F.
POST CURE	6 HRS.	305 F.

### ➤ TRAINING

Allen-Bradley systems  
Absorber systems



# THE END

## THANK YOU

Rick Putnam  
3/18/2003

Mechanical Engineering Group  
Accelerator Systems Division

